Three-dimensional electrical structure of the Hangai and Gobi-Altai Mountains in Mongolia recovered with a FEM code and adaptive meshes

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The Hangai is an intra-continental mountain range in central Mongolia with unknown orogenesis. Previous seismic and gravitational studies revealed a low velocity/low density anomaly, but the understanding of the uplift process remains vague. Instead, detailed 2-D and 3-D conductivity models beneath the Hangai and surrounding areas can facilitate the understanding of the Hangai Mountain uplift. To obtain such models, we conducted a magnetotelluric survey in the Hangai region. During three field campaigns (2016-2018) a total of 328 stations were installed on a regular 50 x 50 km grid and along several profiles with a finer spacing. The grid covers a total area of 360 x 700 km, including the Hangai Dome, its surroundings and a part of the Gobi-Altai mountain range. The estimated transfer functions (impedance, tipper, and phase tensor, as well as intersite impedance/phase tensor) cover a wide frequency range (from 0.008s to 3000s at most and up to 16000s at some stations) and are of high quality due to low electromagnetic noise, although affected by galvanic distortions.

We employ a 3-D FEM code (GoFEM) to obtain an image of the conductivity structure below the survey area. Locally refined unstructured meshes are used to ensure numerical accuracy with a sufficiently fine discretisation of the inversion domain, while keeping the computational cost feasible, and also allow for static shift correction. Models obtained by an inversion of the impedance tensor resolve the subsurface down to the Lithosphere-Asthenosphere boundary (LAB). The models show a strong subdivision, the northern part with the Hangai Dome is characterized by a predominantly layered structure and a shallow LAB, whereas the Gobi-Altai in the south is laterally more heterogeneous with a deeper LAB. The transition is rather abrupt and follows the previously known South Hangai Fault Zone. Additionally, we imaged two large anomalous vertical conductors in the lithosphere, which are likely related to the uplift process.